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Creation Date:

Approval to submit was given by:

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Section 1: INVENTION DESCRIPTION

Title of Invention: CATALYSTS AND PRETREATMENT METHOD FOR LOW-TEMPERATURE NO OXIDATION

Patent Evaluation Committee: \$CHEMICAL

CPSC Code: 09.00.00

Originating Country Code: US

Related Disclosure(s): None

Section 2: PROBLEM & SOLUTION

Description or Comments: The invention is comprised of catalyst formulations, and a method of pretreating those catalysts, for promoting the low-temperature oxidation of nitric oxide (NO) to nitrogen dioxide (NO₂) in the exhaust from lean-combustion engines (especially diesel engines). The catalysts convert NO to NO₂ in the exhaust upstream of a diesel particulate filter (dpf) and the NO₂ promotes regeneration of the dpf (i.e. combustion of trapped carbonaceous particulate) at temperatures much lower than attainable by reaction with O₂ or NO.

Attachment: See Section:9 ATTACHMENTS

Section 3: PRIOR ART

Description or Comments: A brief search in MicroPatent yielded the following patents dealing with catalyzed diesel particulate filters: EP0341832; WO9939809; US4902487; US5100632; EP0160482. Johnson Matthey PLC first introduced the

concept of a continuously regenerable particulate filter (or trap) based on NO oxidation to NO₂ over an oxidizing catalyst (SAE 890404). The present invention differs in the type of catalysts employed.

Attachment: See Section:9 ATTACHMENTS

Section 4: NEW TECHNOLOGY

**Description or
Comments:**

Attachment: See Section:9 ATTACHMENTS

Section 5: DETAILED DESCRIPTION

**Description or
Comments:**

The invention is comprised of catalyst formulations and a method of pre-treating those formulations for optimizing the low-temperature oxidation of NO to NO₂ in the exhaust from an internal combustion engine. The so-produced NO₂ is desirable for effecting the low-temperature combustion of diesel particulates and/or as a way of eliminating NO_x when subsequently reacted with reducing agents such as hydrocarbons, ammonia, or urea. Details of the catalyst formulations and pretreatment method are given in the attached file. However, the essential features are the following: 1) Catalysts containing Pt as the active metal supported on zirconia-stabilized silica provide a significant enhancement in low-temperature activity and thermal stability compared to similar catalysts prepared on either silica or zirconia alone. 2) Pretreating (pre-aging) the catalysts in a gas mixture containing 500 ppm NO and 3% O₂ at 600-650°C resulted in extremely high conversion of NO to NO₂ (up to 96% conversion) under the most favorable reaction conditions. 3) Addition of other oxide components to the catalyst, namely those known to have strong acid sites (TiO₂, P₂O₅, WO₃, B₂O₃, Al₂O₃, and the heteropolyacids H₃PW₁₂O₄₀ and H₄SiW₁₂O₄₀) further increased the activity of the Pt/ZrO₂-SiO₂ catalysts at low temperatures and allowed a decrease in the amount of Pt required from 2-5% to 1% without loss of performance.

Attachment: See Section:9 ATTACHMENTS

Section 6: DATES

Record(s) of Completion: First recorded on _____ in Albert Shigapov's
laboratory book.

Date of Completion:

First Production Use:
[Model and Date]

Section 7: CATEGORY QUESTIONS

Invention Category: Chemical

- 1 Does the invention relate to a new composition or a method of preparing a composition or both (select Composition, Method or Both)?

Inventors Response: The invention relates to new compositions of exhaust catalysts.

- 2 Provide a description of the elements of the composition including the proportions of each. If the composition is an organic compound, please provide the chemical structure and proposed chemical name.

Inventors Response: The basic catalyst is comprised of Pt (1-5%); Zirconia (ZrO_2) (3-20%); and Silica (SiO_2) (remainder). Additional materials that provide further benefit to the activity and durability of the catalysts are the strong acid materials listed in the detailed description section of the disclosure above. These acid materials were all added to the Pt/ ZrO_2 - SiO_2 catalyst at a concentration of 0.0005 mol per gram.

- 3 Provide starting materials and briefly describe how the composition was made.

Inventors Response: The attached file gives details on all of the starting materials and preparation methods. In brief, the ZrO_2 - SiO_2 support was made by taking commercial silica gel and impregnating it with zirconium citrate ammonium complex, then subsequently impregnating with hexachloroplatinic acid. In the case where additional acid components were added, these were impregnated from the corresponding salts or acids, in most cases in aqueous solution.

- 4 Described any intermediate products necessary to understand the composition.

Inventors Response: None

- 5 Provide yield information.

Inventors Response: Not applicable.

- 6 Provide any measurements made on the composition (melting point, IR spectrum, transmission wavelength, hardness, etc.)

Inventors Response: Pore size distributions, specific surface areas, XRD, Pt dispersion, chemical reactivity tests.

- 7 What can you do with this composition?

Inventors Response: Use it in the exhaust from internal combustion engines to convert NO to NO_2 with high efficiency at low temperatures

- 8 How is it used?

Inventors Response: See 7.

- 9 Does it replace an existing material?

Inventors Response: Most known applications of this type employ Pt on only the simple one-component supports of silica or alumina.

- 10 How does the composition differ from prior art compositions (either describe a different element or different proportions and how these differences provide improved properties)?

Inventors Response: This invention foremost uses a zirconia stabilized form of silica which imparts improved NO oxidation function and better thermal stability compared to Pt/ SiO_2 alone. The addition of other strong acids further increases the activity or allows the use of less Pt for a given level of activity.

Section 8: MISCELLANEOUS ITEMS

Is it a Government Contract?:

No

If yes, Government Contract Number:

Identify a government agreement, partnership, consortium, or other company involved with conception or first building of the invention:

If disclosed to non-Company personnel, identify recipient and date:

Section 9: ATTACHMENTS

File Name Click on File Name to view and print it.	Description
28302NO2invdiscl.doc	The file is a microsoft word document describing the catalysts and method of preparation as well as reviewing prior work and providing discussion on the mechanism by which enhanced performance is obtained.
2830228302charts.xls	This file contains the charts illustrating the invention. These charts show the NO conversion to NO2 over different catalysts and the comparison of conversion obtained with equilibrium NO conversion at different temperatures.

Section 10: INVENTORSHIP

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